January 9, 2001

Dr. Philip K. Hopke
Clarkson University
Box 5810
8 Clarkson Avenue
Potsdam, NY 13699-5810

Dear Dr. Hopke:

This letter transmits a preliminary agenda and a discussion paper relevant to the January 22, 2001 meeting of the Clean Air Scientific Advisory Committee (CASAC) Technical Subcommittee for Fine Particle Monitoring. This January 22 meeting presents an opportunity for much of the monitoring community (Academia, vendors, State/local agencies, EPA) to explore opportunities for accommodating emerging technologies into routine air monitoring networks.

We continue to appreciate the Subcommittee's willingness to participate in the ongoing review of the PM monitoring program, and look forward to meaningful discussions on future directions for monitoring technology. Should you have any questions, please contact me (919-541-4650).

Sincerely,

/s/

Richard D. Scheffe
Leader
Monitoring and Quality Assurance Group

Enclosures

cc: Joe Mauderly
Subcommittee
John Bachmann
John Vandenberg
Deborah Mangus
William Wilson
Paul Solomon
David Mobley
Joe Paisie
Russ Wiener
Roy Zweidinger
MQAG Staff

DRAFT

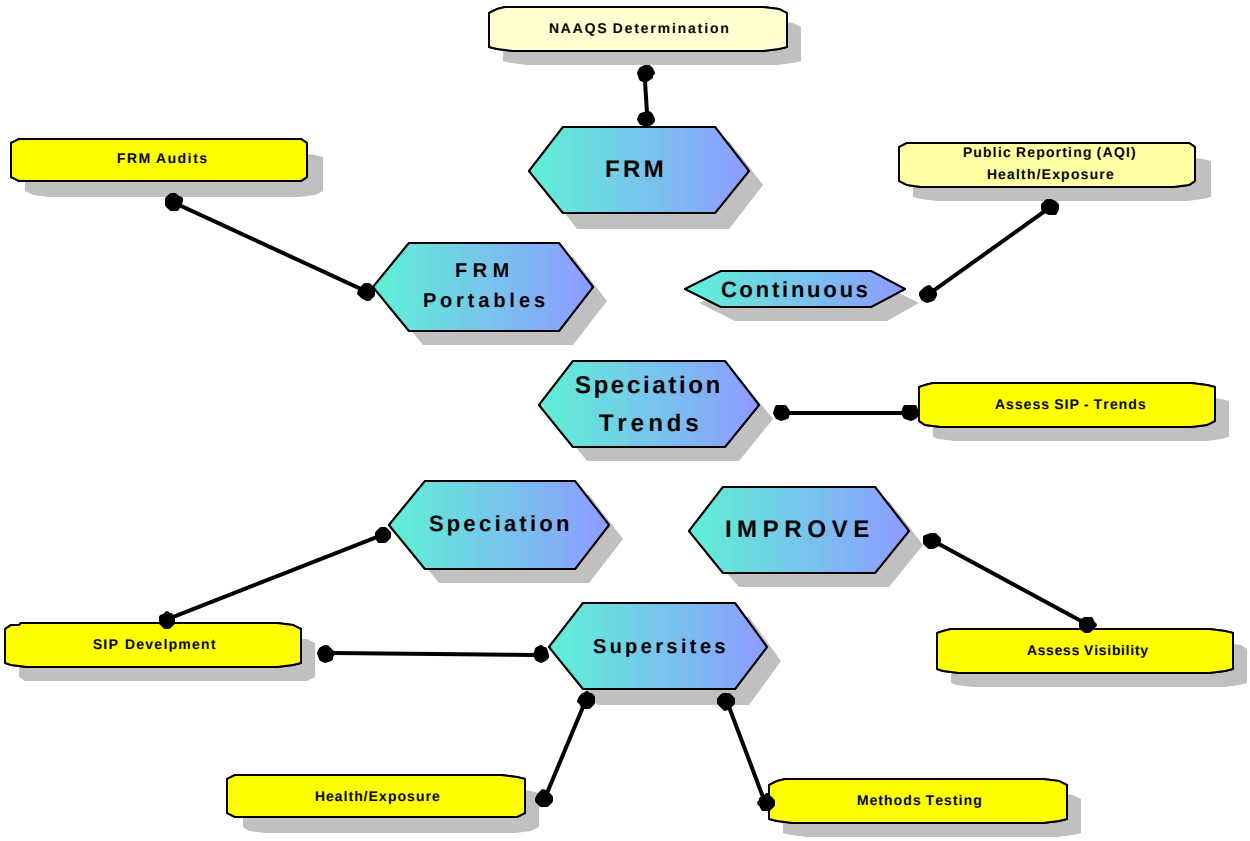
Particulate Matter Monitoring Technology: Revisiting method equivalency and accommodating continuous and other advanced methods

Introduction

Since the July 1997 promulgation of the $PM_{2.5}$ standard and Federal Reference Method (FRM), enormous resources have been spent on deployment and operation and maintenance (O&M) of $PM_{2.5}$ monitoring methods. The majority of these resources (~62%) have been spent on capital acquisition and O&M for the FRM samplers which are primarily used in attainment decisions. Resource expenditures have also been used for acquisition and O&M of speciation samplers (~33%) and continuous monitors (~4%). Each of these instruments are used for other monitoring objectives. If a sampler could be used for more than one objective, then the resource savings could be gained not only for the actual cost of the equipment but more importantly for the O&M, and if applicable, filter analysis of the additional sampler. Despite a substantial allocation of resources in overall PM monitoring implementation, very little methods development work has been performed in the area of $PM_{2.5}$ continuous monitors. This lack of development combined with requirements for lengthy field testing in multiple sites and high statistical correlations for designation as a $PM_{2.5}$ Federal Equivalent Method (FEM) have resulted in no applications for designation of continuous $PM_{2.5}$ monitors as FEM. Over the last 3 years many monitoring agencies have expressed a strong desire for the development and acceptance of continuous methods for use as FEM's. This sentiment has been expressed in a number of venues including the AWMA PM2000 conference in Charleston South Carolina; STAPPA/ALAPCO; SAMWG; and a workgroup of QA and monitoring staff from EPA-OAQPS, Regions, and State and local agencies. In response to this growing sentiment, and with the anticipation of a potential coarse particulate standard, the CASAC Subcommittee on Fine Particle Monitoring identified the need to dedicate a future meeting to the subject of PM continuous monitors during their April 2000 discussions with EPA. This paper is written to provide a starting point for dialogue on the use of PM continuous monitors, including possible options for acceptance of PM continuous methods. The paper identifies possible options that may help push continuous monitoring towards equivalency including: using the Data Quality Objective (DQO) process to determine what the equivalency criteria for PM continuous monitors should be; approval of non-designated PM monitoring methods across spatial scales of a entire monitoring agency, Region, or Regional planning area; more flexibility in the use Correlated Acceptable Continuous (CAC) monitors; more flexibility in areas significantly above or below the NAAQS; commitment of substantial resources for the next generation of PM continuous monitors; and waiting for a new indicator of PM fine for which a continuous reference method may be more applicable.

Monitoring Objectives for Continuous PM Methods

As indicated above there is a need to monitor with respect to several monitoring objectives. The most recognized monitoring objectives are: protection of public health - which requires comparing FRM mass data to the National Ambient Air Quality Standard (NAAQS); timely public reporting - as part of the Air Quality Index (AQI), which requires use of a continuous monitor; assessing the components of PM - which requires use of speciation or IMPROVE monitors, and independent performance evaluations - which requires use of a portable FRM sampler. However, public health research can be aided by continuous monitoring to provide more complete and better time resolved data. Such data will open additional opportunities for investigating the time relationships between exposure and disease. In addition continuous monitoring data can also provide additional insights into atmospheric processes that may make it easier to develop effective and efficient air quality management strategies. Most other monitoring objectives can be accomplished in combination with one of the objectives listed above. Other monitoring objectives specific to continuous monitoring include assessing diurnal variation in PM, sector sampling, model evaluation, and assessing peak short term exposure. The illustration below identifies the major monitoring objectives and network elements by linking the primary monitoring objective to the appropriate network element.


NAAQS Determination
FRM
FRM Audits
Public Reporting (AQI)
Health/Exposure
FRM
Portables
Continuous
Speciation
Trends
Assess SIP - Trends
Speciation
IMPROVE
SIP Develpment
Supersites
Assess Visibility
Health/Exposure
Methods Testing

The need to perform each of these monitoring objectives to meet regulatory and non-regulatory needs has been well established in other documents. If the network elements identified in the middle of the illustration can accomplish multiple monitoring objectives identified on the perimeter, then the most cost effective network element can be chosen to accomplish the monitoring objective required. This can only be accomplished if the network element meets the monitoring objective of the data user. Since no $PM_{2.5}$ continuous monitors are currently approved for use as a FEM, they cannot fulfill the monitoring objective of NAAQS determinations at this time.

Current Regulatory Framework

The NAAQS and reference method for PM are defined in 40 CFR Part 50. Regulatory requirements for designation of federal reference and equivalent methods are defined in Part 53. The network requirements for surveillance of ambient air quality at State and local Air Monitoring Stations (SLAMS) are detailed in Part 58. Each of these portions of the regulation are inter-related. This paper makes no issue with regard to the NAAQS for $PM_{2.5}$, nor the reference method for the determination of fine particulate matter as $PM_{2.5}$ in the atmosphere as defined in Part 50, appendix L. Subjects for discussion in this paper are the requirements for equivalency designation as defined in Part 53 and the applicability of monitoring methods as defined in Part 58.

The requirements for equivalency designation are broken into 3 categories for $PM_{2.5}$ methods. Class I equivalency requirements are similar to those of the FRM as Class I equivalency represents those methods with only minor deviations from the $PM_{2.5}$ FRM. Class II equivalency covers other filter based methods. While class III equivalency covers all other monitoring technologies including continuous methods. The relative rigor of requirements for equivalency increases as one deviates from the reference method in order to assure designated methods will yield data of a consistent quality to the reference method. However, the downside to having strict testing and performance requirements for these FEM's has been that the equivalency program has become an obstacle (perceived or real) to incorporation of advanced methods.

Why initiate changes now?

The primary reasons to move forward now for accommodation of PM continuous methods are:

- With the increased monitoring and related manpower demands on the State and local monitoring agencies, there is a continuing high level of frustration from these monitoring agencies, vendors and the research community that no FEM's have been qualified as a result of EPA's strict approach to equivalency.

- A robust FRM data set is now available, and a continuous data set is growing.

- A quality assurance report has been drafted that includes precision and bias estimates

of each $PM_{2.5}$ FRM sampler. This provides the baseline for how well the FRM's are performing.

- The EPA is considering using 2 FRM samplers; one with a WINS impactor and one without to calculate the coarse particulate fraction as the new reference method for coarse particulate. This approach is under field study and if approved, may result in more filter-based FRM samplers.

- If a coarse particulate standard is promulgated it's expected to replace the existing PM10 standard. The monitoring network that supports the existing PM10 standard has multiple continuous methods approved as FEM's. These PM10 continuous methods would potentially be available for use in any redesign of the network, but can only be useful if they are still considered FEM.

- Any promulgation of coarse particulate standard requires opening up regulations for change. Any changes for accommodation of continuous method acceptance can be piggy-backed to new regulation for coarse particulate standard.

- A parallel effort on a national monitoring strategy provides framework for change.

- In the context of the national research program focused on the health effects of airborne particulate matter, the increased time resolution, completeness, and coverage that continuous monitors would provide could produce data that are important in understanding the association of exposure and disease.

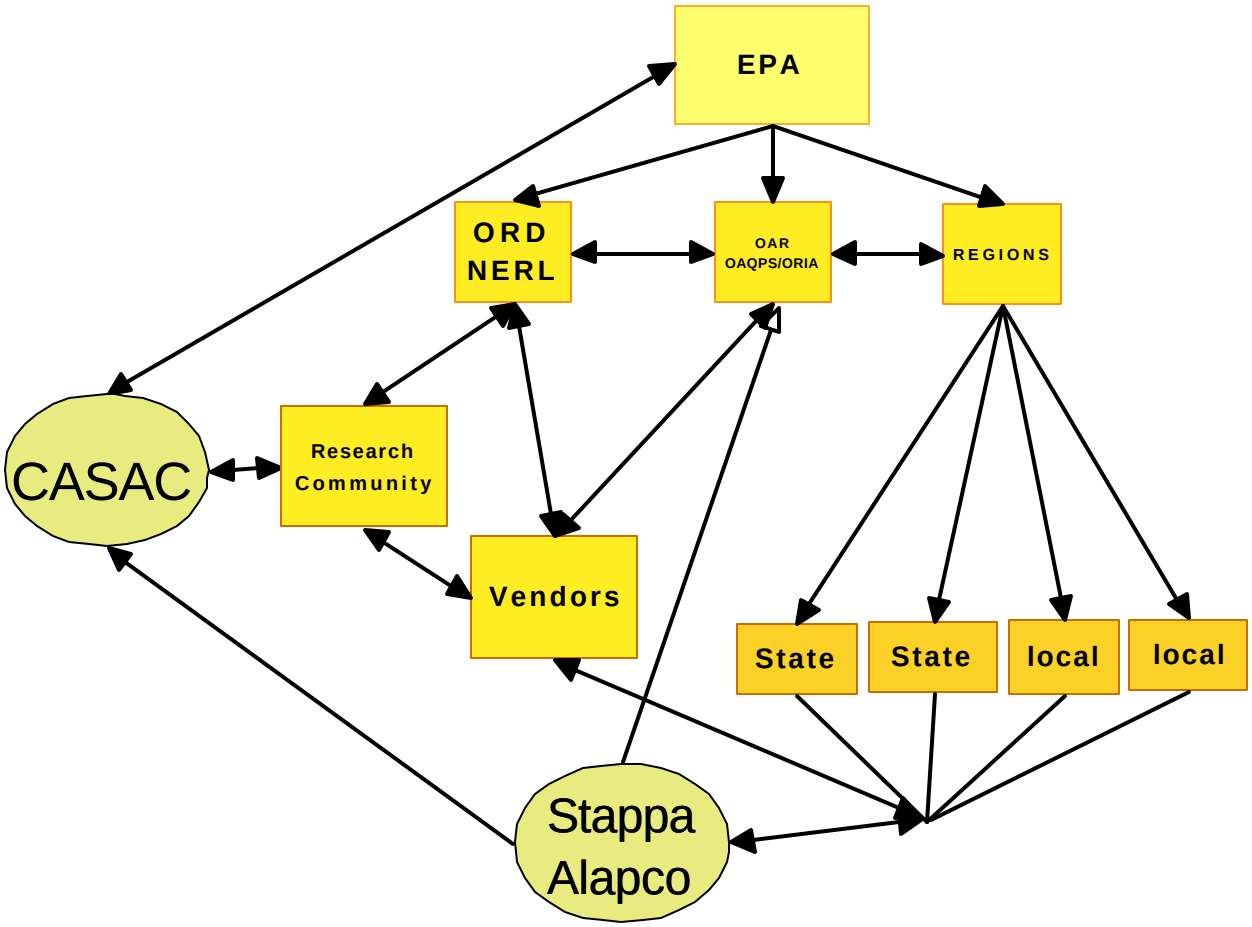
- The relationships between highly time resolved PM data and the simultaneously collected gaseous pollutant data (CO, O_3, etc) could be useful in the testing of air quality models and the development of air quality management strategies.

- Specifically addressed in April 2000 CASAC meeting for discussion at a future meeting.

- Lack of resources in EPA ORD to maintain reference and equivalency program.

Roles

In order to be successful any changes in policy for use of continuous monitors need the input of all affected stakeholders. The illustration below identifies the linages between each of the stakeholders.



Listed below are the perceived roles of each of the major stakeholders:

EPA ORD

EPA ORD should be prepared to identify what flexibility it can offer in the Reference and Equivalency (R&E) program. Also, if there are expected resource limitations with regard to the R&E program, ORD should clearly identify its ability to participate in anything more than a application review of a candidate equivalent method. Additionally, if some limited resources do become available, EPA

ORD should clearly state what methods development work it can accomplish and communicate that to the other stakeholders. For the long term, ORD should provide input into the national monitoring strategy for its role in methods development.

EPA Office of Air and Radiation (OAR)

The OAR is comprised of several offices. Two of those offices; the Office of Air Quality Planning and Standards (OAQPS) and the Office of Radiation and Indoor Air (ORIA) are involved in ambient air PM monitoring. OAQPS is responsible for overall direction, guidance and implementation of national air monitoring programs. In this capacity OAQPS is the EPA coordinating office for ensuring the monitoring networks meet the needs of the data users. OAQPS should clearly define the maximum allowable uncertainty of the $PM_{2.5}$ monitoring data in order to make attainment decisions. This process should consider what the original data quality objectives were as well as the performance of the $PM_{2.5}$ network so far. This will be used as an input to any new equivalency criteria. ORIA is an emerging technical support arm for OAQPS, the Regions, and the technical lead for coordinating tribal air monitoring activities as well as certain QA functions. ORIA should review any proposed changes in use of continuous methods. ORIA should also work to ensure Tribal monitoring program are included in any Regional or multi-Regional PM continuous monitoring networks.

EPA Regions

EPA Regions should collaborate and be represented either through the lead monitoring region or by making some assessments of the appropriate regional representativeness of PM and bringing multiple stakeholders to participate. For example, the western Regions should consider having one representative who is knowledgeable in the components and methods for continuous PM being employed in the west. Each Region should work to ensure communication with monitoring agencies under their direction on any proposed changes to the use of PM continuous monitors.

State, local, and Multi-state Organizations

Individual States and local agencies should collaborate through STAPPA/ALAPCO and the multi state planning organizations (NESCAUM, MARAMA...) to designate a few lead representatives who are experts in the use of PM continuous methods as well as the use of the data. These staff will be most valuable when they can provide success stories for the larger monitoring community to build upon. Experts should be knowledgeable in the successful application of any one PM continuous methods (TEOM, Beta Attenuation, CAMMS, others) or use of that data.

Research Community and CASAC

The research community should provide technical input as to the best approaches for each of the major PM continuous methods. The community should also provide a sounding board for which

continuous methods are most promising with respect to application in regulatory networks. The formal input of these stakeholders will occur through the CASAC sub-committee, where any major changes to equivalency will be reviewed.

Vendor Community

Each of the vendors who are interested in the acceptance of PM continuous monitors should be willing to explore the current advantages and disadvantages of their products. They should be asked to review any draft language for potential flexibility in the equivalency program to determine if it would entice them to submit an application package. Vendors should be prepared to identify when the incentives for their companies to invest in development of continuous and other advanced methods outweigh the risks.

Data Quality Objectives for the $PM_{2.5}$ Monitoring Data

In spring 1997, a DQO process was performed for the $PM_{2.5}$ measurement program to clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of decision errors. The outcomes of this process were limits on precision and bias based upon the smallest number of sample values available in a 3-year period. The DQO process determined that the correct attainment decision will be made at a specific site 95 percent of the time if precision and bias are maintained at the acceptable levels. The tolerances for precision and bias are identified in section 2.5 of Appendix A to part 58 of the regulation, which states: "Measurement uncertainty for Automated and Manual $PM_{2.5}$ Methods. The goal for acceptable measurement uncertainty has been defined as 10 percent coefficient of variation and +/- 10 percent for total bias." A summary of that information is available in the $PM_{2.5}$ model QAPP section 7 available from the AMTIC web site at http://www.epa.gov/ttn/amtic/amticpm.html under "Quality Assurance".

Options and Recommendations

Listed below are several options that may help accommodate more use of continuous methods in the PM monitoring program. These options are a first attempt in brainstorming how to accommodate additional use continuous methods. Additionally, a combination of some of these and other options may be necessary in order to fully integrate continuous methods for use as an equivalent method.

In considering these options, the staff recognize that over the next few years a variety of continuous methods will be incorporated into health and air quality related studies. In addition to mass measurements, some of this work will focus on physical and chemical components of fine particles. Such research may suggest refinements to the indicator and averaging time in future standard reviews, as well as point towards appropriate directions for future continuous methods either for designations or for insights into more effective attainment strategies.

Increase acceptable tolerances of Class III equivalency through application of the DQO process

The criteria for acceptable levels of tolerance between FRM and candidate equivalent methods were promulgated in Part 53 of the regulation before any FRM samplers had been designated. 1999 $PM_{2.5}$ data quality (Quality Assurance Report, The $PM_{2.5}$ Ambient Air Monitoring Program, draft October 2000) indicate that the FRM samplers are meeting the data quality objectives of the $PM_{2.5}$ monitoring program. The goal for acceptable measurement uncertainty has been defined as 10 percent coefficient of variation (CV) for total precision and +/- 10 percent for total bias. Therefore, with the precision and bias estimates now available for each of the reference methods, that information can be used to establish a new data quality objective process for correlation of continuous $PM_{2.5}$ monitors. The likely success of the DQO process for increasing the class III equivalency tolerances and still meeting the goal for acceptable measurement uncertainty is also enhanced as a result of continuous monitors effectively running as daily samplers. If an attainment decision is to be made with 3 years of data at no less than 75 percent completeness, then one may expect at least 821 sample days available for comparison to the standard. The original DQO's for FRM measurement uncertainty were based upon a 1 in 6 day sample schedule at 75 percent completeness over 3 years. This results in at least 137 valid samples for use in a valid attainment decision. Thus, the larger number of samples from the continuous monitor could potentially provide a determination that the measured $PM_{2.5}$ concentration is within an acceptable level of uncertainty to the actual $PM_{2.5}$ concentration with the same or greater statistical confidence. The performance of a DQO process can provide for a more practical, applications based approach that can specify the appropriate criteria for equivalency.

Approval of non-designated $PM_{2.5}$ methods

Section 2.4 of the 40 CFR part 58, Appendix C regulation identifies that specific individual sites can be approved for use of non-designated $PM_{2.5}$ methods. Requirements for an approval center on a 4 season demonstration of comparability to the FRM. Criteria for meeting comparability are the same as those used in designation of a class I equivalent samplers. Although available, this provision in the regulation has not been attempted. In order to make this provision more attractive for monitoring agencies, consideration should be given to making continuous monitors accepted throughout an agencies network or even across all agencies in a Region or Regional planning area. The basis for this should be that a contiguous monitoring network utilizing the same method will provide consistent data quality. By having a higher number of operational continuous methods using the same approach, more QA monitors (collocated continuous, collocated FRM's, and performance evaluation FRM's) will be available to ground truth the network. Monitoring agencies in a Region or Regional planning area can collaborate on the best available technology to meet the monitoring objective. The selection of one or more PM continuous monitoring technologies would be based upon what is most appropriate for use in their network(s) and without regard to whether it would work at a site outside of their network. In order to assure a conservative test of the continuous method, the sites closest to the annual NAAQS may be chosen as test sites in a network. These test sites would be expected to maintain both FRM's and continuous monitors.

Change CAC to optimize site visitation resources

Although not currently allowed, the Correlated Acceptable Continuous (CAC) monitors may provide for a decrease in resource needs if they were to be allowed for use in attainment decisions and flexibility were provided in the requirements for sample schedule. Current CAC provisions only allow for sites with a daily sampling requirement to be reduced to a 1 in 3 day sample schedule. This provides for no decrease in the number of site visits since the site will still have to be visited every 4 days. A change to the use of CAC's would only be resource effective if a change to the sample schedule of the FRM sampler were tied to the maintenance needs of the continuous monitor. For instance, if the site is visited every 2 weeks to check the continuous monitor, then have 4 samples taken on the days leading up to the maintenance. Load 4 new samples on that visit; however, do not have the FRM sampler start for 10 days. This would provide for 26 visits of 4 samples per visit in a year. If one applies the 75 percent completeness criteria then this approach would yield at least 78 valid samples per year. Note the current 1 in 3 day schedule for the FRM at a CAC site provides for at least 91 valid samples a year at the 75 percent completeness criteria. If the site were visited every 12 days with 4 samples recovered each time, this would result in approximately 90 valid samples with the 75 percent completeness criteria applied.

Allow for more flexibility in areas significantly above or below the NAAQS

Much of the discussion so far has centered on strategies that ensure attainment decisions around the standard are made with an acceptable level of confidence. However, what if the $PM_{2.5}$ concentration measured by a monitoring agency were substantially above or below the NAAQS? Then an assumption could be made that as the measured $PM_{2.5}$ concentration moves farther away from the standard, that measurement error is more acceptable since it should still not result in a wrong decision. Accordingly, agencies could allocate more of their monitoring resources to those network elements (continuous, speciation...) that still provide mass data for comparison to the NAAQS, but also encompass other monitoring objectives.

Commit Substantial Resources to Public/Private effort for next Generation of PM Continuous Monitors

Since the NAAQS promulgation in 1997, some agencies have identified the need to shift away from filter based methods. These agencies cite greater utility of data, improved data transfer, and reduced operator intervention through use of continuous monitors. However, they fail to accommodate the link between ambient monitoring data captured with filter based methods and the health research. However, what if a continuous method were developed that could meet the comparability requirements in Part 53? If a continuous monitor were approved as an equivalent method then it could be used in attainment decisions at any site in the national network. In order to develop a continuous monitor that would meet the comparability requirements in all 4 seasons at the multiple sites identified in the equivalency testing, a substantial resource effort would have to commence. This effort likely would entail collaboration among EPA, the research community, and the vendor community so that each agreed with the process to develop the potential continuous method. Without collaboration enormous resources may be expended that misses the need of the other groups.